

CLAIMS

1. An apparatus for introducing a biological material which has:
 - one or more packing units in which a mixture solution containing a large number of magnetic supports carrying a biological material to be introduced into a host such as cells,
 - 5 together with a large number of said hosts in solution is pooled; and
 - an introduction treatment unit which controls a magnetic force affecting the inside of said packing unit so as to move said magnetic supports relatively with respect to said host in solution to introduce said biological material into said host.
2. An apparatus for introducing a biological material according to claim 1, wherein
10 said introduction treatment unit has: a magnetic source which can apply a magnetic force to the inside of said packing unit; and a magnetic force control unit which controls said magnetic supports to move relatively with respect to said host, by changing the relative position or the velocity between said packing unit or said mixture solution and said magnetic source, or the magnetic force itself due to said magnetic source.
- 15 3. An apparatus for introducing a biological material according to either one of claim 1 and claim 2, wherein said introduction treatment unit moves said magnetic supports and said host relatively to each other in a state where a large number of said magnetic supports in the solution contained in said packing unit are developed in solution by the magnetic force.
- 20 4. An apparatus for introducing a biological material according to any one of claim 1 through claim 3, wherein said magnetic support is a particle having a major axis and a size allowing entry into said host along a major axis direction.
5. An apparatus for introducing a biological material according to any one of claim 1 through claim 4, wherein an introduction adjuvant for helping to introduce a biological
25 material into said host is contained in said packing unit together with said biological material.
6. An apparatus for introducing a biological material according to any one of claim 1 through claim 5, wherein said magnetic support has a carrier for carrying said biological

material.

7. An apparatus for introducing a biological material according to claim 4, wherein in said magnetic support, both ends or one end along said major axis are formed in a tapered shape.

5 8. An apparatus for introducing a biological material according to any one of claim 1 through claim 7, wherein said introduction treatment unit performs introduction treatment based on the properties, the amount, or the density of said host, said biological material, or said magnetic support.

9. An apparatus for introducing a biological material according to any one of claim 1
10 through claim 8, wherein said packing unit has a liquid passage through which said mixture solution can pass, and has a pressure adjuster which draws and discharges the solution by adjusting the pressure in said liquid passage, as said magnetic force control unit.

10. An apparatus for introducing a biological material according to any one of claim 1
15 through claim 9, provided with a transfer mechanism which enables relative movement between said packing unit and the position of the introduction treatment where said introduction treatment unit can perform the introduction treatment with respect to said packing unit.

11. An apparatus for introducing a biological material according to any one of claim 1
20 through claim 10, wherein said magnetic source comprises a plurality of electromagnets provided around said packing unit, and said magnetic force control unit electrically modifies the magnitude of the magnetic force of said electromagnets.

12. An apparatus for introducing a biological material according to any one of claim 1
25 through claim 11, having a plurality of permanent magnet blocks or electromagnets serving as said magnetic source which are movably provided around said packing unit, and said magnetic force control unit moves said magnetic sources with respect to said packing unit.

13. An apparatus for introducing a biological material according to any one of claim 1 through claim 12, wherein said magnetic source is an annular magnet having

predetermined magnetic poles which are arranged around said packing unit in a circular tubular shape, and said magnetic force control unit has: a magnetic source transfer unit which enables movement of said magnetic source along the radial direction, axial direction, and the circumferential direction of said packing unit; or a packing unit transfer unit which enables movement of said packing unit; or a mixture solution transfer unit which moves the mixture solution.

14. An apparatus for introducing a biological material according to any one of claim 1 through claim 13, wherein a plurality of said packing units are arranged along a horizontal line, and said introduction treatment unit has: two linear magnetic sources provided with said packing unit therebetween, along said horizontal line, and having magnetic poles provided respectively in positions corresponding to the respective packing units; and a magnetic force control unit which enables relative movement between said magnetic supports and said host by changing the relative position between said packing unit or said mixture solution and said linear magnetic sources, or changing the magnetic force itself due to said linear magnetic sources.

15. An apparatus for introducing a biological material according to claim 14, wherein said linear magnetic source has two linear support bodies provided on opposite sides with said arrayed packing units therebetween, along said horizontal line, and a plurality of permanent magnets or electromagnets arranged at intervals and positions corresponding to the respective packing units, in said linear support bodies.

16. An apparatus for introducing a biological material according to either one of claim 14 and claim 15, wherein each of said packing units has a liquid passage through which a mixture solution can pass, and a pressure adjuster which draws and discharges the solution by adjusting the pressure in the liquid passage.

17. An apparatus for introducing a biological material according to any one of claim 1 through claim 16, wherein said introduction treatment unit has a magnetic separation unit whereby hosts having said magnetic support introduced thereinto or adhered thereto, are attached to the inner wall of said packing unit and separated from the mixture solution in

said packing unit, by controlling said magnetic force applied to the inside of said packing unit.

18. An apparatus for introducing a biological material according to claim 17, wherein said magnetic separation unit has a separation instruction unit which instructs said

5 magnetic force control unit to apply only a unidirectional magnetic force towards the wall of said packing unit.

19. A method of introducing a biological material comprising: a mixing step wherein a large number of magnetic supports carrying a biological material to be introduced into a host such as a cell, and a large number of said hosts are mixed in a solution to make a
10 mixture solution, which is then put into one or more packing units; and an introduction treatment step wherein said magnetic supports are moved relatively with respect to said host by controlling a magnetic force applied to said packing unit, so as to introduce said biological material into said host.

20. A method of introducing a biological material according to claim 19, wherein in
15 said introduction treatment step, said magnetic supports and said host are moved relatively to each other by changing the relative position or the velocity between said packing unit or said mixture solution and said magnetic field, or the magnetic force itself.

21. A method of introducing a biological material according to either one of claim 19 and claim 20, wherein in said introduction treatment step, said magnetic supports and said
20 host are moved relatively to each other in a state where a large number of said magnetic supports in the solution contained in said packing unit are developed in solution by the magnetic force.

22. A method of introducing a biological material according to either one of claim 19 and claim 21, wherein said introduction treatment step uses a magnetic support being a
25 particle having one major axis, and having a size allowing entry into a host along the major axis direction, and moves said magnetic support to enter said host so as to introduce the biological material.

23. A method of introducing a biological material according to any one of claim 19

through claim 22, comprising a separation step after said introduction treatment step wherein said host having said magnetic support entered therein or adhered thereto is attached to the inner wall of said packing unit and separated, by controlling the magnetic force inside of said packing unit.

5 24. A method of introducing a biological material according to any one of claim 19 through claim 23, wherein said mixing step mixes said magnetic support and said biological material to be introduced into said host in solution, so that said biological material is carried in said magnetic support.

25. A method of introducing a biological material according to claim 23, comprising a
10 culturing step wherein after said separation step, in a state where the separated hosts having said magnetic support adhered thereto or entered therein are pooled in said packing unit, said hosts are relatively moved to inside a container containing a medium and said hosts are pooled in said container and cultured.

26. A method of introducing a biological material according to claim 25, wherein in
15 said culturing step, said hosts having the magnetic support entered therein or adhered thereto are separated and removed from the cultured hosts by applying a magnetic force, so as to exclusively obtain purely cultured hosts.

27. A method of introducing a biological material comprising: an introduction step for making magnetic supports carrying said biological material to be introduced into said host
20 collide or encounter with said host using a magnetic force so as to introduce said biological material into said host; a separation step for separating the host having said magnetic support entered therein or adhered thereto; a culturing step for culturing said host using said separated host; and an extraction step for extracting a purely cultured host by separating the host which initially has said magnetic support entered therein or adhered
25 thereto, from inside the cultured host.

28. A magnetic support for introducing a biological material, which is a magnetic support in a particle shape having one major axis, and capable of carrying biological material to be introduced into a host such as a cell, and having a size allowing entry into

said host along the major axis direction.

29. A magnetic support for a biological material according to claim 28, wherein said magnetic support has a carrier for carrying said biological material.

30. A magnetic support for a biological material according to either one of claim 27 and
5 claim 28, wherein in said magnetic support, both ends or one end along a major axis are formed in a tapered shape.

31. An apparatus for introducing a biological material comprising:
one or more packing units containing a mixture solution having a large number of
magnetic supports carrying a biological material to be introduced into a host such as a cell,
10 and a large number of said hosts in a solution;

an introduction treatment unit which moves said magnetic supports relatively
with respect to said hosts in the solution by controlling a magnetic force applied to inside
said packing unit so as to introduce said biological material into said host; and

a perforation treatment unit which perforates said host.

15 32. An apparatus for introducing a biological material according to claim 31, wherein
said introduction treatment unit comprises: a magnetic source which can apply a magnetic
force to the inside of said packing unit; and a magnetic force control unit which controls
relative movement between said magnetic supports and said host by changing the relative
position or the velocity between said packing unit or said mixture solution and said
20 magnetic field, or the magnetic force itself due to said magnetic source.

33. An apparatus for introducing a biological material according to claim 31, wherein
said perforation treatment unit has: a perforation force source which can apply a
perforation force by an electric field, or ultrasound, or the like; and a perforation force source
control unit which controls said perforation force source.

25 34. An apparatus for introducing a biological material according to either one of claim
31 and claim 32, wherein said perforation force source control unit controls the perforation
force source based on the properties, the amount, or the density of said host, said biological
material, or said magnetic support.

35 An apparatus for introducing a biological material according to any one of claim 31 through claim 33, wherein said perforation force control unit or said magnetic force control unit control the introduction treatment and the perforation treatment so as to be executed in spatial or time association with each other.

5 36 An apparatus for introducing a biological material according to any one of claim 31 through claim 35, wherein said packing unit has a liquid passage through which said mixture solution can pass, and has a pressure adjuster which draws and discharges the solution by adjusting the pressure in said liquid passage, as said magnetic force control unit.

10 37. A method of introducing a biological material comprising: a mixing step wherein a large number of magnetic supports carrying a biological material to be introduced into a host such as a cell, and a large number of said hosts are mixed in a solution to make a mixture solution, which is then put into one or more packing units; a perforation treatment step which perforates said host such as a cell; and an introduction treatment step wherein
15 said magnetic supports are moved relatively with respect to said host by controlling a magnetic force applied to said packing unit, so as to introduce said biological material into said host.

38. A method of introducing a biological material according to claim 37, wherein said perforation treatment step is performed by applying a perforation force such as an electric
20 field, ultrasound, or the like.

39. A method of introducing a biological material according to either one of claim 37 and claim 38, wherein said perforation treatment step applies the perforation force based on the properties, the amount, or the density of said host, said biological material, or said magnetic support.

25 40. A method of introducing a biological material according to any one of claim 37 through claim 39, wherein said perforation treatment step and said introduction treatment step are executed in spatial or time association with each other.

41. An apparatus for introducing a biological material according to any one of claim 1

through claim 18, which further comprises: a transfer device which separates and transfers a solution containing a host which has been treated by said introduction treatment unit, and has said magnetic support adhered thereto or entered therein, or a host having the magnetic support adhered thereto or entered therein; a container containing a medium;
5 and a separation unit for separating said magnetic support contained in said container and the host having said magnetic support adhered thereto or entered therein.